# United States Patent [19]

**Lance et al.**

[11] **Patent Number: 4,498,757**

[45] **Date of Patent: Feb. 12, 1985**


[54] **DEMOUNTABLE, MODULAR TONER-FUSER ASSEMBLY FOR ELECTROGRAPHIC PRINT APPARATUS**


[75] Inventors: **Wayne E. Lance**, Orlando; **Wilson P. Rayfield**, Longwood, both of Fla.

[73] Assignee: **Burroughs Corporation**, Detroit, Mich.



[21] Appl. No.: **409,023**

[22] Filed: **Aug. 17, 1982**

[51] **Int. Cl.**[3] ..... **G03G 15/20**

[52] **U.S. Cl.** ..... **355/3 FU**; 432/60; 219/216

[58] **Field of Search** ..... 355/3 FU, 14 FU; 219/216, 469, 470, 471; 432/60; 118/60



[56] **References Cited**

U.S. PATENT DOCUMENTS

3,973,844 10/1976 McCarroll ..... 355/3 FU

4,154,575 5/1979 Edwards et al. ..... 355/3 FU



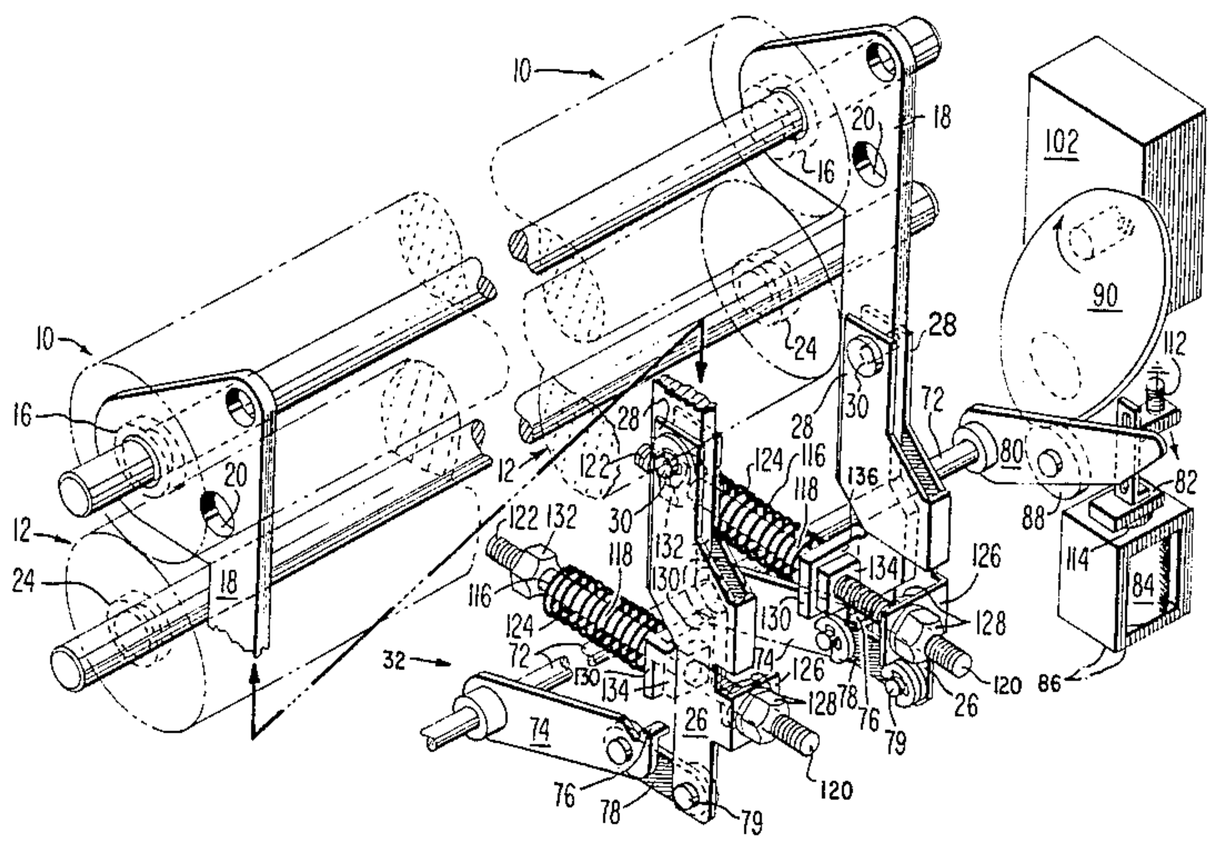
*Primary Examiner*—A. T. Grimley
*Assistant Examiner*—J. Pendegrass
*Attorney, Agent, or Firm*—Carl Fissell, Jr.; Kevin R. Peterson



[57] **ABSTRACT**

A modular, demountable toner fuser assembly for electrographic printing/copying apparatus wherein oppositely disposed adjustable tensioning members are coupled to a dead center linkage such that a pair of confronting pressure rollers operably associated with the dead center linkage can be moved relative to one another so as to provide suitable fusing pressure while being automatically instantly separables in response to any exigency e.g. items jams, tearing, crumpled paper or other nonfeed conditions.


**10 Claims, 10 Drawing Figures**



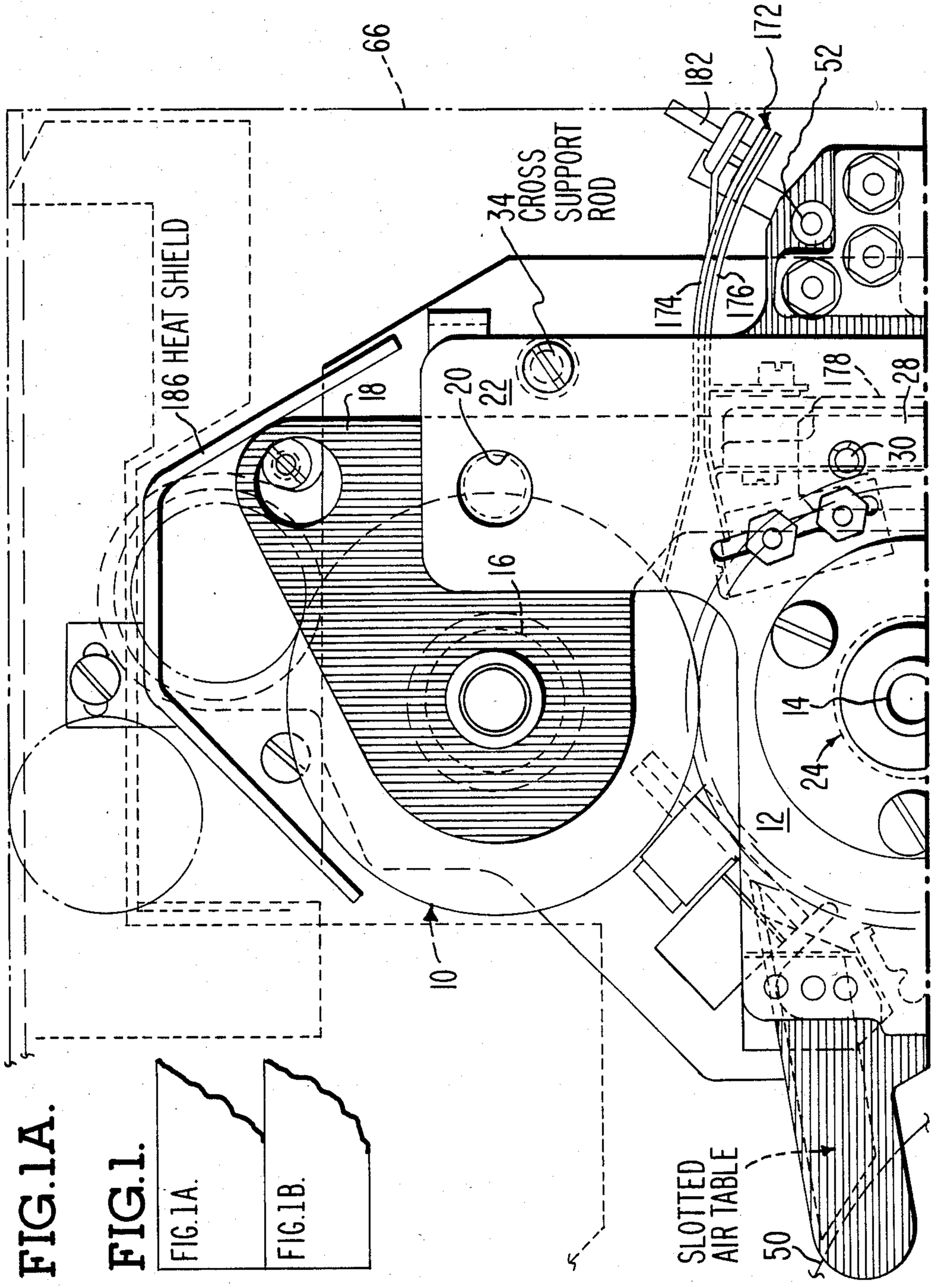



FIG.1A.

FIG.1.

| |
|---|
| FIG.1A. |
| FIG.1B. |

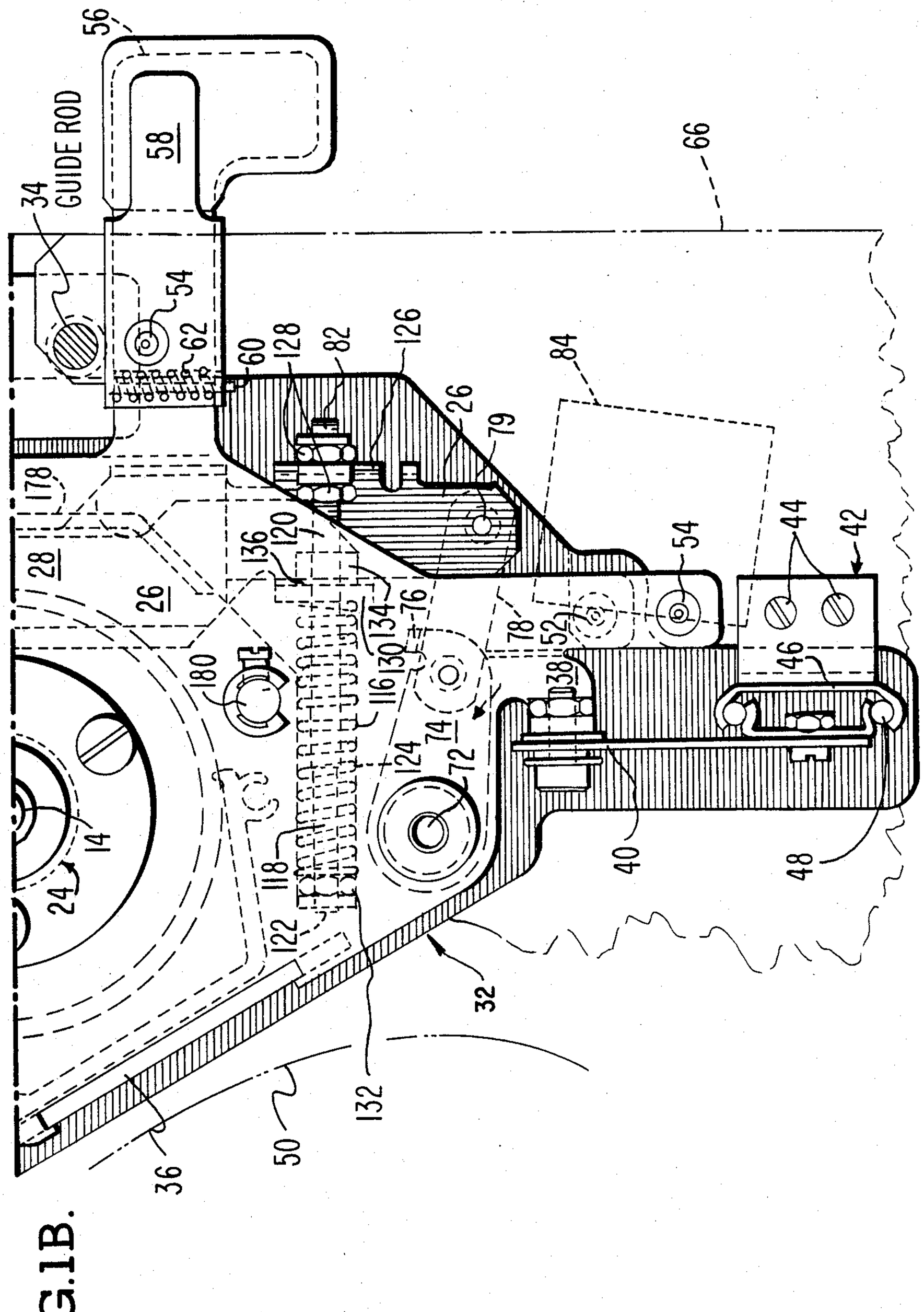

56
58
34
GUIDE ROD
66
54
62
60
128
82
126
84
26
79
178
28
26
136
120
54
44
42
134
76
78
52
180
116
130
38
46
74
124
72
14
24
118
122
40
48
32
36
50
132

FIG. 1B.

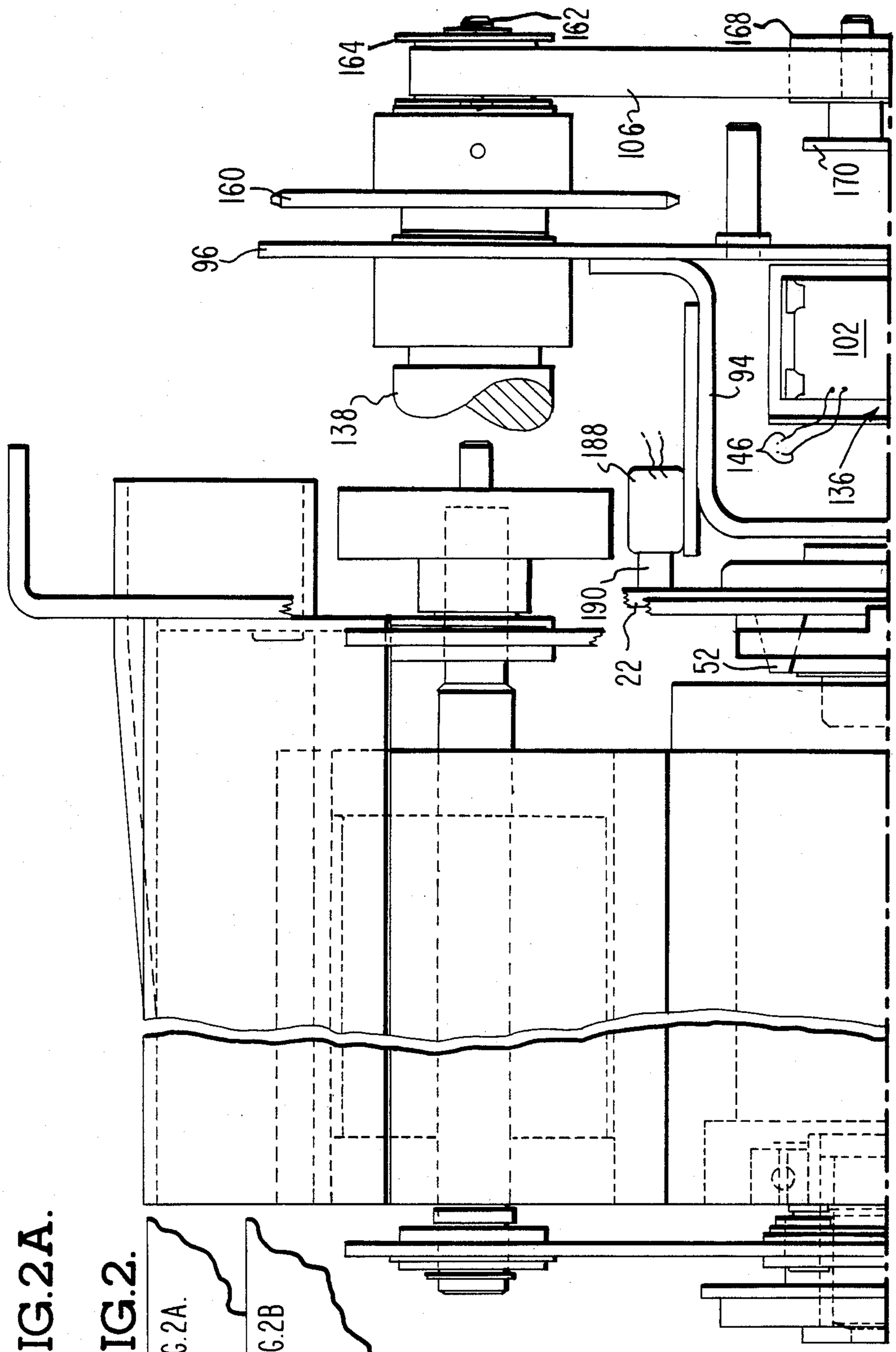

162
164
168
106
160
170
96
102
94
138
188
146
136
190
22
52
47

FIG.2A.

FIG.2.

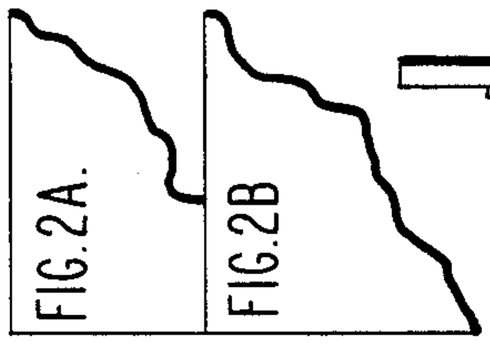


FIG.2A.
FIG.2B

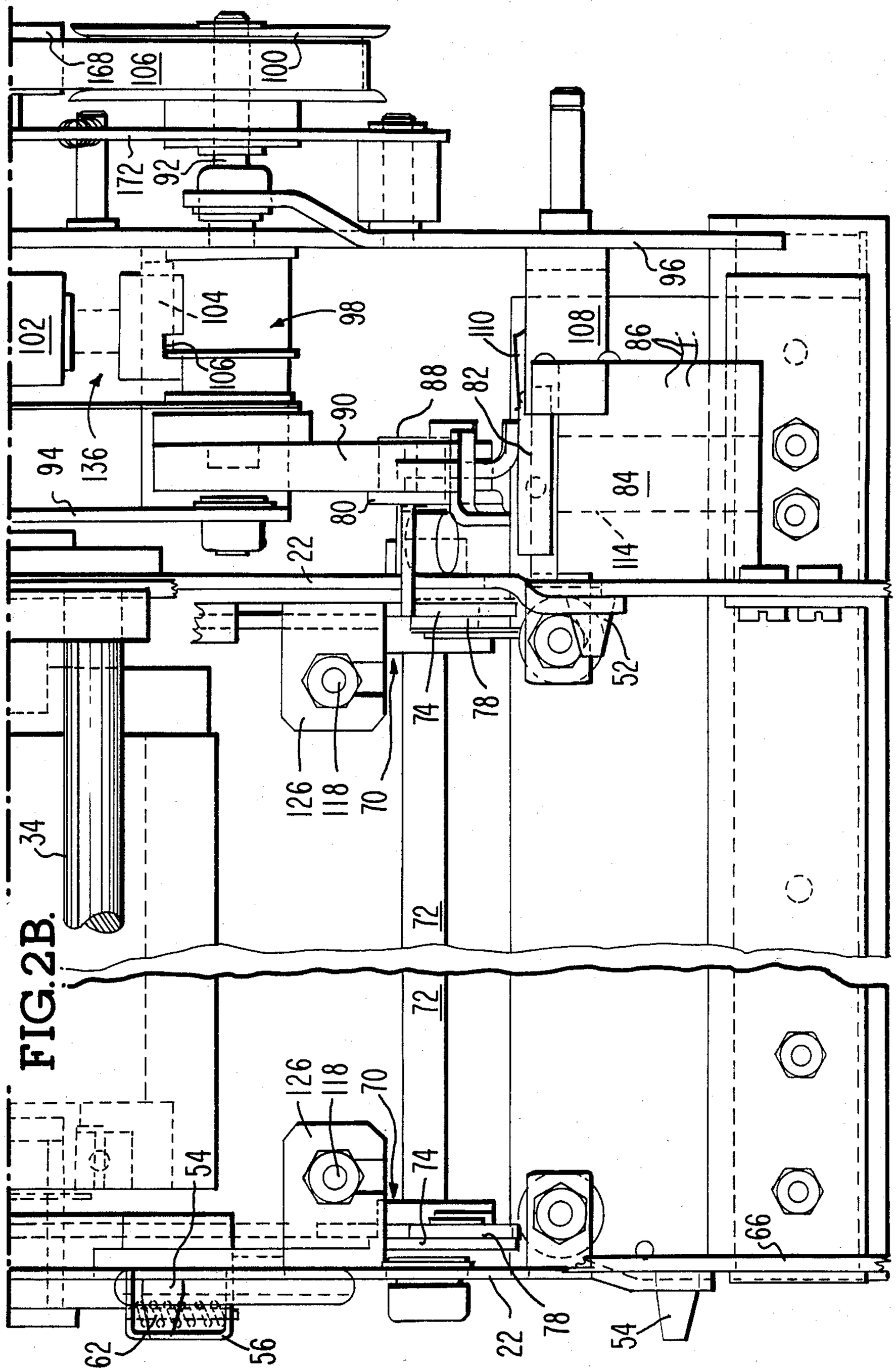

168
106
100
172
92
102
104
98
106
110
108
86
88
82
90
94
136
80
84
114
22
96
52
74
78
126
118
70
72
34
54
62
56
66

FIG.2B.

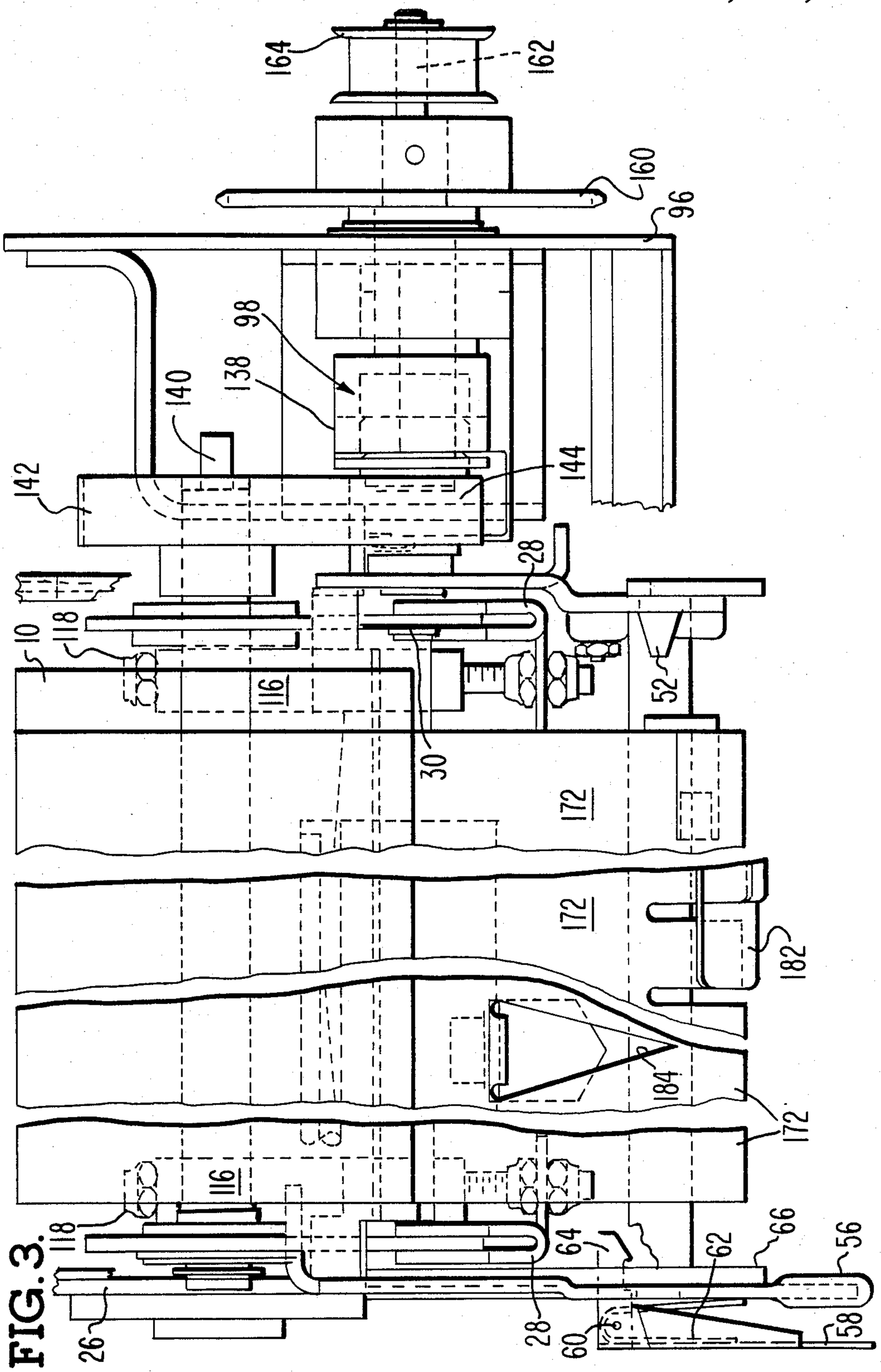

164
162
160
96
98
138
140
142
144
28
10
118
116
52
30
172
182
184
172'
118
64
62
66
56
26
28
60
58

FIG. 3.

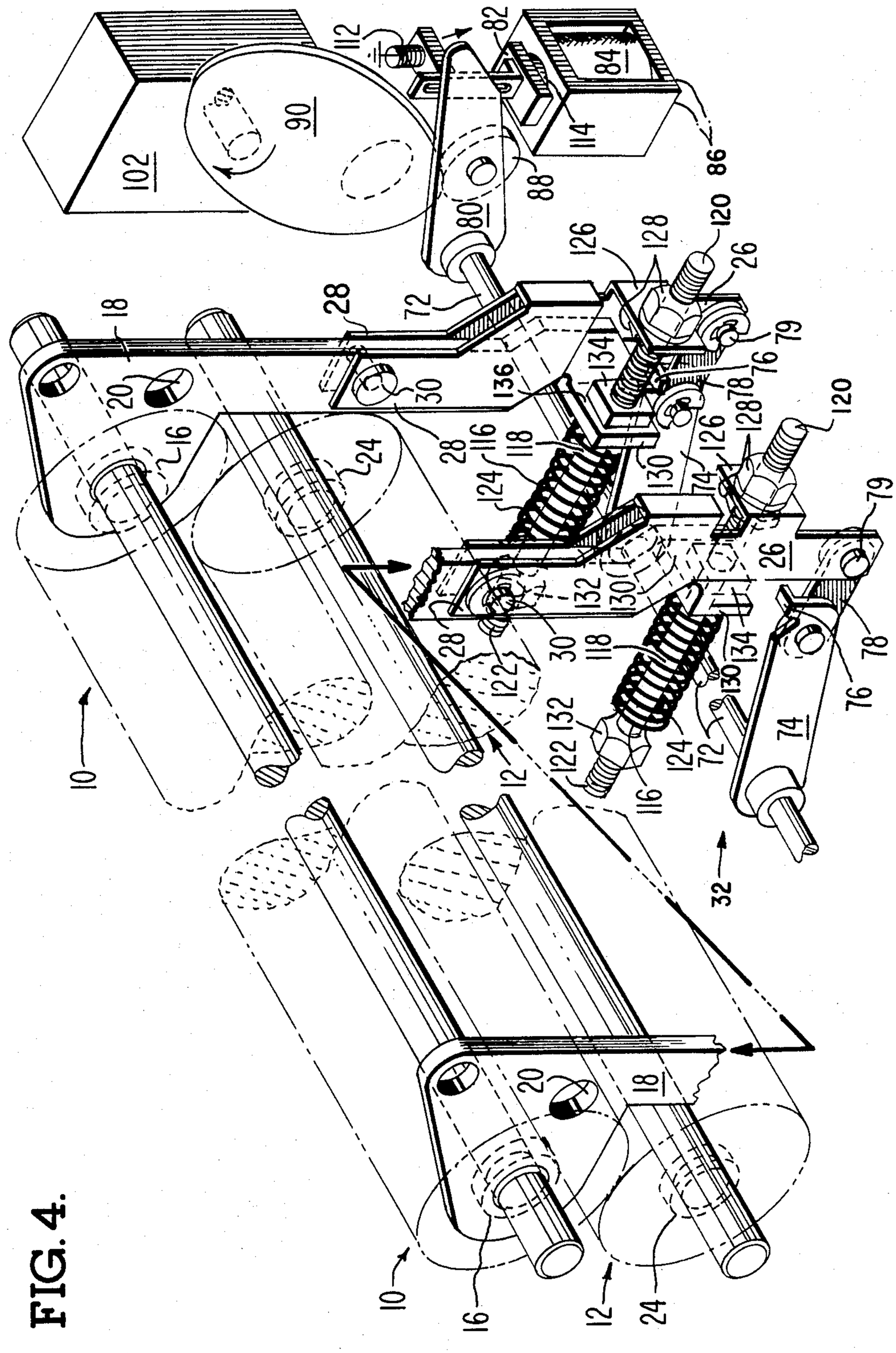
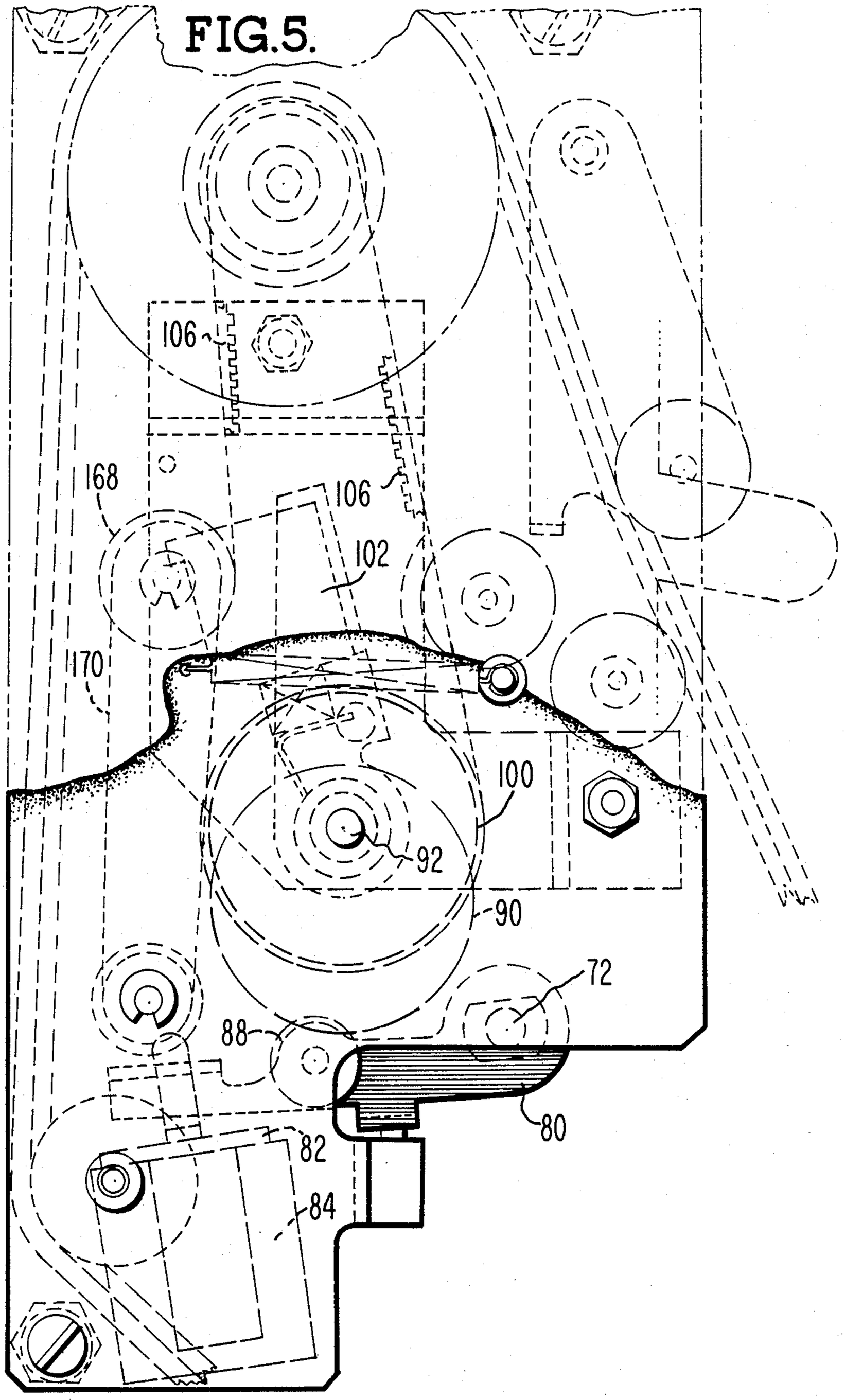

112
82
84
114
102
90
88
80
86
120
126
128
26
18
28
72
79
134
136
76
78
30
20
16
24
116
118
124
130
74
132
122
10
12
32

FIG. 4.

FIG.5.



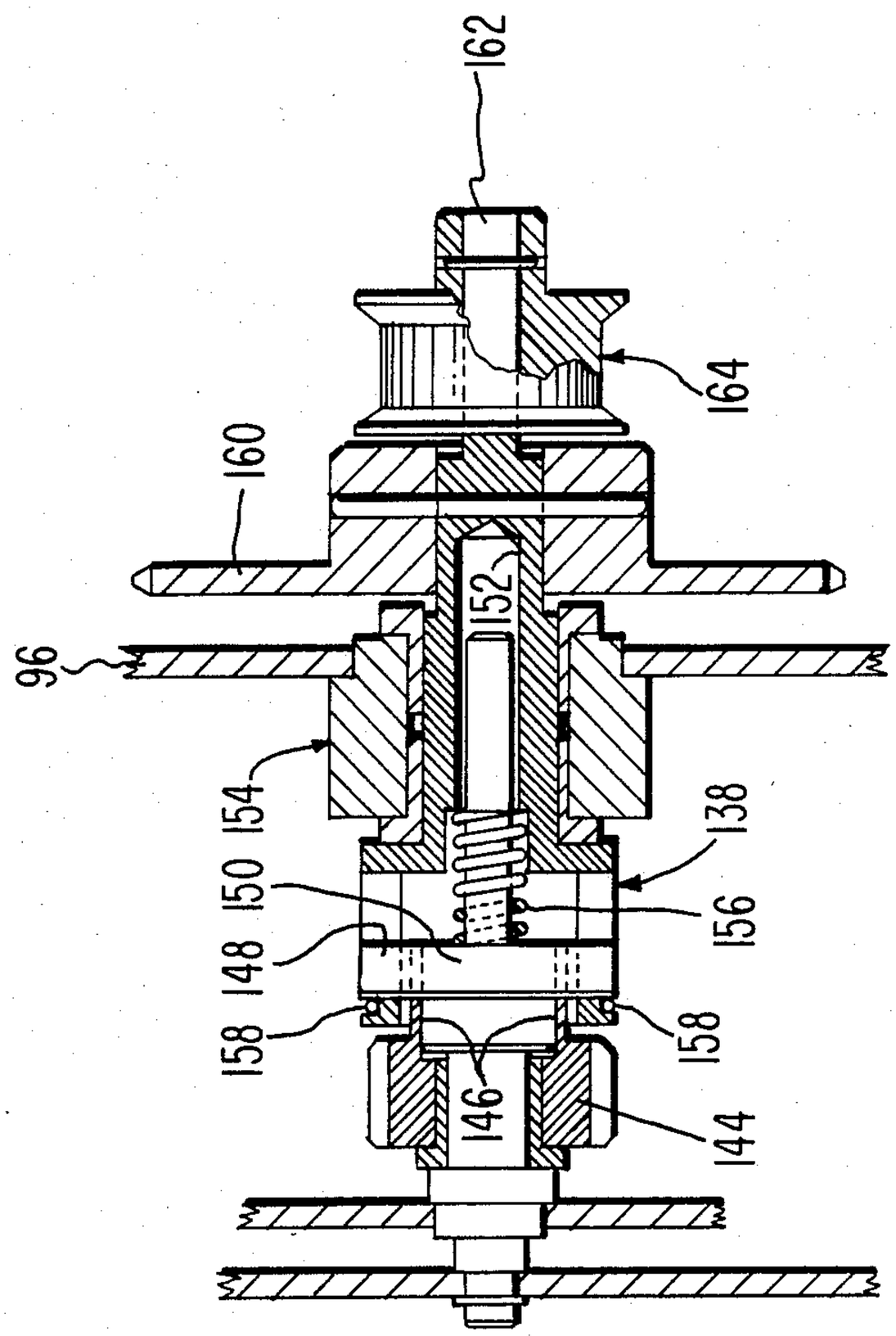



FIG.6.

# DEMOUNTABLE, MODULAR TONER-FUSER ASSEMBLY FOR ELECTROGRAPHIC PRINT APPARATUS

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to electrophotographic apparatus and more specifically to a demountable, modular, toner fuser assembly utilizing both heat and pressure and having automatic means for applying and releasing such pressure to produce an image on sheet items.

2. Description of the Prior Art

Most, if not all, electro-photographic apparatus employ some method and mechanism for making the latent image produced by the electrographic device visible to the human eye. So called toning material is usually used which can be liquid or dry as the case may be, but in each type means must be employed to "fuse" the toner into the paper which is most often used to provide the fusible image carrier.

Liquid toner type fusers employ a radiant heater to dry the dispersed liquid prior to exiting the visible copy to the operator. Some dry toner fusers employ a thin film of silicone oil as a release agent for the fuser roller. This oily material tends to be quite messy and in many cases never really dries but often appears as a shiny surface after the paper has passed through the pressure rolls associated with such devices. In addition the oil sticks on the paper which tends to make the paper stick to other objects that it touches which is highly undesirable.

## SUMMARY OF THE INVENTION

The present invention solves these and other associated problems in a new, novel and heretofore unobvious manner by providing a pair of dry silicone or teflon covered rollers in confronting, rolling contact with one of the two rollers rockably pivoted relative the other roller. A signal actuated overcenter or dead center cam and cam linkage operably connected to the pivoted roller in conjunction with an adjustable spring loading mechanism permits the two rollers to be biased together under a preset pressure while enabling the two to be automatically separated, for jams, apparatus stoppage as well as routine end-of-copy-run situations. Elongated fixed supports in conjunction with locating pins enable the modular fuser assembly to be withdrawn from the path of movement of the copier drum and the sheet items being printed or copied. A rockably mounted, arcuate paper guide is disposed adjacent to the "nip" of the two fuser rollers and acts to provide an exiting item throat so as to deflect both the sheet items and the heat radiated from the lower hot roller of the pair. A demountable heat deflector is located between the copy drum and the hot roller supported by a fixed U-shaped yolk. Rotative power is coupled to the fuser roller through a novel split coupling and signal actuated single revolution clutch permitting the modular fuser assembly to be dismounted from the base assembly without disrupting the driving mechanism. An optical paper timing sensor is located on the rockably mounted paper guide adjacent to the "nip" between the two fuser rollers.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates the arrangement of the drawing FIGS. **1***a* and **1***b* depicting the present invention;

FIGS. **1***a* and **1***b* together illustrate a front end elevational view of the fuser assembly of the present invention;

FIG. **2** illustrates the arrangement of the drawing FIGS. **2***a* and **2***b;*

FIGS. **2***a* and **2***b* together illustrate side elevational view of the present invention;

FIG. **3** is a partial top plan view of the present invention with parts broken away to accommodate the size of the physical hardware to the drawing sheets;

FIG. **4** is an isometric view of the fuser assembly embodying the present invention;

FIG. **5** is a schematic view from the rear of the apparatus, and

FIG. **6** is an illustration of the drive coupling between the fixed and movable portions of the fuser assembly.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The modular, demountable, retractable fuser assembly embodying the present invention is seen in FIGS. **1–5** inclusive to comprise an upper backup horizontally elongated drive roller **10** and a lower elongated, heated idler roller **12**. The exterior surface of each of these two rollers is or may be covered, coated or overlayed with dielectric heat resistant material such for example as teflon or silicone, as will be described later on herein.

Lower heated idler roller **12** FIG. **1***b* is provided with a heating element **14** extending therethrough for purposes to be described shortly. Upper roller **10** is journaled in bearings **16** disposed in oppositely arranged vertical roller links **18** for rockable, pivotal movement about horizontal pivot pins **20** in oppositely disposed, parallel vertical side frames or plates **22**. Idler roller **12** is journaled in bearings **24** in inboard and outboard (L-R) side plates **22** and is maintained in rolling surface contact with upper roller **10**.

Left and right vertical spring links **26** are provided with integral upper U-shaped cross section members **28** FIGS. **2***a* and **3** and are pivotally coupled to roller link members **18** at their upper ends by pivot pins **30** and to a broken or dead center linkage assembly **32** FIGS. **1***b* and **4** at their lower ends as will be described in detail shortly herein. Right and left inboard and outboard side plates **22** are rigidly separated by means of upper and lower cross coupling rods or shafts **34—34** and at the front or left side FIG. **1***b* by a rigid extruded structural member **36**.

The lower end of each side plate **22** is provided with a bent tab or tang **38**, the end of which is bolted securely to the vertically disposed forwardly and rearwardly movable horizontal drawer slide member **40**. The fixed portion **46** of the drawer slide **40** is attached to the base main frame by bolts **44** through brackets **42**. Bearings **48**, between the fixed and movable members **40** and **46**, moving on a bearing guide bolted to member **40**, enable the fuser assembly, as a modular unit, to move back and forth along the guide rail (cross rod) **34**.

In order to accurately secure the fuser assembly in operative relation to the photo-optical drum **50** with which it is associated a plurality of alignment members are employed. As seen in FIGS. **1***a* and **1***b* an upper and lower inner, vertically offset pair of relatively short, tapered alignment pins **52—52**, respectively, cooperate

with an upper and lower outer vertically offset pair of tapered alignment pins **54—54** respectively together with rigid cross support guide rod **34** the four tapered pins **52** and **54** permit the assembly to be movable, forwardly and rearwardly, providing access for service, repair, maintenance and/or when necessary, and required, complete removal of the fuser from the base machine with which it is operably associated.

Integral with the external outboard side plate or frame **22**, viewing the fuser from in front, is an integral, horizontally projecting handle member **56** (FIGS. **1***b* and **3**). Extending slightly forwardly of handle **56** and overlying the upper portion thereof is a paddle shaped latch **58**, hinged at the left end on a pivot pin **60** and biased forwardly i.e. latched, by means of a spring **62**. The rearwardly extending, right angled portion of latch **58** is notched as at **64** FIG. **3** so as to catch i.e. latch, the edge of external vertical frame member **66** when in the latched or closed position shown.

The present invention is directed to automatic signal controlled means for engaging and disengaging the heated pressure roller **12** from the driver roller **10** and for maintaining the two rollers **10** and **12** under a preset pressure when in the engaged or driving condition. It has been determined that to provide good, clear, crisp, clean "no smudge" copy with ordinary paper stock both heat and pressure are required. A roller pressure of 100 lbs end of roller produces excellent copy under continuous usage.

However, loading the two rollers together and maintaining them in this condition for extended periods of non-rolling use may cause them to take a permanent set. The surfaces tend to become eccentric and "out-of-round". This produces poor copy as well as creating a host of associated problems.

The dead center linkage **32**, as seen most clearly in FIG. **4**, comprises a dead center linkage cross shaft **72** mounted for pivotal rocking movement between opposite side plates **22—22**, as will be described shortly herein, and includes a pair of enlarged rear links **74**, the forwardly extending outboard end of each one of which has a bent over tang **76**. Members **74—74** are secured to and pivotally movable with cross shaft **72**. A pair of smaller front links **78—78** are arcuately, pivotally connected to the forward end of respective rear links **74**. The forward end of each front link **78** is rockably connected by pivot pin **79** to the lower end of a respective vertical spring link **26**. The upper yoke of U-shaped end **28** of each link **26** surrounds the lower end of a respective L-shaped vertical roller link **18** as seen in FIGS. **2***a* and **4**.

The inboard distal end i.e. toward the center of the assembly (right in FIG. **4**) of dead center linkage cross shaft **72** is provided with a cam follower link **80** rockable therewith. The rightward end of link **80** is provided with a short vertical attachment post to which is secured the clapper **82** of control solenoid **84**, energized over lines **86**, for purposes to be described shortly herein. A cam follower roller **88** is rotatably disposed intermediate the ends of link **80** for rotatable engagement with an enlarged drive cam **90**. A short cross shaft **92** FIG. **2***b* journaled between an angled support plate **94** and the inboard main frame member **96** carries a one revolution clutch **98** and an external drive pulley **100** at the out board end thereof. Electromagnet **102** has its clapper **104** engaging the stop collar **106** on shaft **92** effectively controlling the rotation of shaft **92**. A microswitch **108** has its actuator **110** extending beneath a bent tang (not shown) secured to link **90**, for purposes to be described shortly.

From the foregoing it is readily apparent that clockwise (cw) rotation of dead center linkage shaft **72** by rotation of pulley **100** will rock dead center linkages **74** and **78** from an initial and upwardly angled position FIG. **4**, to a substantially (although not completely) flat, horizontal position, simultaneously rocking spring links **28** and roller links **18** about the fixed pivot points **20** bringing upper driven roller **10** into surface contact with the lower heated roller **12**. A retracting spring **112** for upper roller **10** is secured to the inboard side plate **22** and to the forward end of cam follower link **80**. For separating the two rollers as will become apparent shortly.

Rotative movement of cam **90** engagable with follower roller **88** on link **80** which causes the (cw) movement of linkage **70** concurrently causes clapper **82** to seat against the pole piece **114** of solenoid **84**. This movement brings upper movable roller **10** into contact with lower roller **12**. Energization of solenoid **84** maintains the roller **10** in contact with roller **12**. Deenergization of solenoid **84** enables the return spring **112** to retract roller **10** away from roller **12**.

Mere surface contact however, between rollers **10** and **12**, is insufficient for fusing the toner into the paper, (not shown). To produce the pressure required between rollers **10** and **12** a pair of oppositely disposed, adjustable force, regulator spring, roller tensioning members **116—116** are provided FIG. **1***b*. Each spring tensioning member **116** is seen to comprise an elongated spring shaft **118**, the opposite ends of which are threaded, as at **120** and **122** while the central intermediate portion is smooth finished to retain a force regulator spring **124**. Springs **124** are retained on shafts **118** at their extreme rightward ends by means of inwardly bent tangs **130** on depending members **18**, and inner and outer nuts **132–134**. The rightwardly extending end of each shaft **118**, to the right of tangs **130**, is adjustably disposed through a second tang **126** on the depending end of members **26**. The adjusting nuts **132** permit the spring force to be easily adjusted and accurately maintained to produce approximately 100 pounds of force between rollers **10** and **12**. A slight gap or space (0.035 to 0.040 in.) **136** FIG. **1***b* between tang **130** and the nut **134** on shaft **118** indicates that the desired force measurement is provided.

In order to fit the requirements that the modular, fuser assembly be demountably, slideably, retractably, moveable from the base machine for service, repair and maintenance, a novel coupling assembly **138** is employed as part of the present combination. As seen in FIG. **3**, the inboard end of shaft **140**, which rotatably supports rockable pressure roller **10**, carries an enlarged toothed wheel **142** in rolling engagement with a smaller pinion gear **144** rotatably secured to the outer side plate **22**. Pinion gear **144** FIG. **6** is provided with a castellated external edge, the notches or slots **146**, of which are adapted to engage the cross arm **148** of a key **150**, such as a woodruff key. Key **150** is slidably retained in an elongated slot **152** in a coupler **138** against the tension of coil spring **156** by means of a clamp ring **158**. Coupler **138** is rotatably mounted in and extends through vertical wall **96** of the base machine. The outboard end of coupler **138** carries an input drive sprocket wheel **160** which is pinned to the central shaft **162** and is driven from the base machine drive by means of a chain (not shown). A toothed pulley **164** on the outboard end of

shaft **162** acts as a power takeoff for toothed pulley **100** FIG. 2*a* via belt **106** FIG. 2*b* and tension roller **168** carried by spring biased rockable idler arm **170** FIG. **5**.

As earlier mentioned herein the fuser roller i.e. hot roller **12** is employed to fuse the toner particles (not shown) to the paper sheet items (not shown) as the latter are drawn through the fuser assembly. To provide the required high heat, heating element **14** comprises a tungsten filament lamp (not shown) disposed in a quartz envelope (not shown) which is fixedly disposed within a cylindrical bore in heated roller **12**. An electrical connector (not shown) at one end of the lamp connects the lamp with a suitable source of electrical potential (not shown).

Because of the possibility of sheet item jams, which, while minimal, can occur without warning, a movable sheet item guideway or throat **172**, FIGS. **1***a* and **3**, is provided. The arcuately curved upper and lower sheet metal item guide plates or members **174–176** are secured to an insulation housing **178**, the lower portion of which is mounted to a rockable cross shaft **180** FIG. **1***b*. The surface of the insulation housing **178** carries a polished heat reflective member (not shown) which acts to contain the high heat developed by the heater **14**. So as to permit the operator to have immediate access to the sheet items should a jam occur, the throat or guideway is pivotally movable clockwise (cw) biased by a return spring (not shown). An insulating handle **182** FIG. **1***a* enables the operator to rock the guideway (cw) against the urging of the return spring thus exposing the pathway of the items for manual removal of any jams. Visual access openings effectively permit the operator to view the item passageway for item monitoring.

A top cover heat shield **186** FIG. **1***a* of insulating plastic is secured over the top of the fuser assembly and is attached to the rear main frame of the base machine so that it remains fixed even though the fuser assembly is withdrawn from the machine frame as for service, repair and maintenance. An interlock microswitch **188** has its actuator **190** extending forwardly (leftwardly FIG. **2**) so as to contact-engage the rear wall structure **22** of the slidably movable portion of the fuser assembly. Closure of the switch contacts allows current to flow through wires **146** to coil **102** actuating clutch **136** whenever current is supplied by base machine. The resulting rotation of the cam **90** and the follower link **80** causes switch actuator **110** to be depressed closing the contacts of switch **108** thereby indicating that the fusing apparatus is functioning.

## OPERATION

With the printer-copier electrographic apparatus in operation the cam **90** has been rotated by the drive member **100** so as to close the rollers **10** and **12** together and the electromagnet **84** has now been energized so as to hold the clapper **82** against the pole piece **114** which in turn means that the 100 pound force exerted at opposite sides of the two rollers is now effective and the rollers are in driving engagement. Sheet items can now be fed through the device and fused in the ordinary course. With the 100 pound force on each roller and with paper between the two rollers, it is very difficult it not impossible to release the paper should a jam occur or should the machine shut down. Of course, it is possible to pull the fuser out of the printer, which in fact would cause the rollers to disengage. But, because of the relatively high pressure another problem presents itself and that is that the rollers take a permanent set if they are held together in one spot for a relatively long time. So, in order to make it easier and more efficient to remove the paper if there happens to be a jam or a shut down of the mechanism, the dead center cam and linkage automatically releases the 100 pound force, and this release will occur whether there is a jam which stops the machine or whether in fact the machine is stopped for some other purposes.

If the machine stops for any reason a signal to the solenoid **84** releases the clapper **82** which because of the spring tension on the roller **10**, the upper roller is immediately snapped away from the lower roller **12** and the two rollers separate. This mechanism is energized and deenergized by the software (not shown) in the machine base frame assembly. The timed delay for the "start-up" of the machine is also related to the software and the heat is kept on the heated roller **12** for a relatively short time after which the complete assembly is shut down.

It is noted that when the two rollers **10** and **12** touch, the over center cam **90** has been moved approximately forty-five degrees. At the point where the rollers touch the force between the two rollers increases rather dramatically and the compression springs provide the required 100 pound load. However, because of the moment arm with the one half inch pivot arm and the five inch pivot arm below, the springs are only required to exert about 33 pounds of force on the two links. The 100 pounds of force is developed on the opposite end. In addition the 33 pound force is further reduced by a longer link down to the dead center linkage. Thus, the cam **90** is not required to exert that much effort on the cam follower roller. As the dead center linkage approaches dead center the cam force becomes even lighter. The linkage is designed to stop just before dead center so that the electromagnet **84** is only required to hold the clapper **82** in position. Meanwhile, cam **90** continues back around 180 degrees and stops in the upright position where it is clear of the linkage and follower roller **88**. At this point the cam follower **88** is being held down by the electromagnet. Once there is a jam the electromagnet is switched off and the cam follower can then "pop up". It is lifted by the spring **112** which serves to cause the two rollers to separate moving the upper roller away from the lower roller.

Assuming that it is necessary or required for the fuser assembly to be slid out of the main frame this is easily accomplished by unlatching the assembly and pulling the fuser outwardly toward the operator. This disengages the pinion gear **144** FIG. **6** from the woodruff key **150** while the remainder of the drive mechanism remains fixed at the back of the machine. With the fuser now slid out on the long slider rod it is possible to arcuately move the paper guide and insulating support arcuately downwardly to remove any paper which might become lodged within this area of the device.

By virtue of the regulator springs **116** a certain amount of clearance between the spring bolt head and the supporting tab is provided and this clearance, which is set once as an original adjustment, correctly guarantees that the correct spring force will be applied to the fuser rollers.

What we claim:

**1**. Apparatus for fusing toner in an elecrographic printing/copying apparatus comprising

(a) a modular, demountable, toner fuser assembly comprising a pair of confronting roller members; means mounting one of said roller members for

pivotal movement relative to the other of said roller members;

force regulator means interconnected to said mounting means including means for adjustably loading said rollers into engagement under a prescribed regulator loading force including means providing a visual indication of said loading force;

dead center linkage operably interconnecting said mounting means effective when moved in one direction to instantly separate said rollers;

(b) means for moving said dead center linkage from a nonload position wherein said rollers are out of engagement to a full load position wherein said load is effectively multiplied to the prescribed force with the rollers in tight engagement;

(c) signal activated means constraining said dead center linkage in said full load position; and

(d) means for automatically retracting said dead center linkage and said roller members to a nonload position effectively permitting said toner fuser assembly to be mechanically disengaged and removably separated from said means for moving said dead center linkage and said signal activated means.

**2**. The invention in accordance with claim **1** wherein each of said roller members is resiliently covered with substantially identical material and wherein one of said roller members includes heater means extending axially thereof.

**3**. The invention in accordance with claim **1** wherein said roller member mounting means comprises oppositely disposed rockable links fixedly pivoted intermediate the ends with said one roller member rotatably disposed at one end of said rockable links and the opposite end of said links carrying said means for adjustably loading said rollers.

**4**. The invention in accordance with claim **3** wherein said adjustable loading means further comprises oppositely disposed, cantilever mounted, force regulator springs surrounding individual respective shaft members including means for increasing and decreasing the force on said springs effective to alter the load on said roller members.

**5**. The invention in accordance with claim **1** wherein said dead center linkage comprises a cross shaft interconnecting said roller member mounting means and including oppositely disposed pivoted links interconnecting said cross shaft and said mounting means and provided with control means operably engageable with said signal activated means.

**6**. The invention in accordance with claim **1** further including an indexing spring clutch separable from said toner fuser assembly and means operably coupled to said clutch effective to pivotally move said dead center linkage to bias said roller members into engagement under the prescribed load.

**7**. The invention in accordance with claim **1** wherein said signal activated means comprises an electromagnet and wherein the clapper of said electromagnet is operably coupled to said dead center linkage so that said electromagnet is capable of holding said dead center linkage under reduced force as the linkage approaches dead center.

**8**. The invention in accordance with claim **1** wherein said means for retracting said dead center linkage comprises a coiled spring on said fuser assembly.

**9**. The invention in accordance with claim **1** further including means integral with said mounting means providing means for visually checking the regulator loading force on said roller members.

**10**. The invention in accordance with claim **1** further including a cam member engagable with said dead center linkage and rotatable to bring said dead center linkage to a position just short of dead center effective to load said roller members together against the tension of said loading means and a coiled spring for releasably retracting said rollers apart in response to release of said signal activated means.

* * * * *